ISSUE PAPER

PROJECT: Boeing
Model MD900
Project # TD4970LA-R

REG.REF.: §§29.1181(a) and §§29.1191(a)(1)

NATIONAL POLICY REF.:

SUBJECT: Designated Fire Zone Regions and Firewalls

ITEM: P-2
STAGE: 4

DATE: June 4, 1998

ISSUE STATUS: COMPLETE

BRANCH ACTION: ANM-140L

COMPLIANCE TARGET: Pre-TC

Equivalent Safety Finding

STATEMENT OF ISSUE:

The engine accessories (fuel control unit, generator, etc.) are located outside the fire zone forward of the firewall required by §§29.1191(a)(1). In order to show compliance with FAR Part 29.1181(a) the compressor and accessory sections of the turbine engine are designated as regions included in fire zones.

BACKGROUND:

The Boeing MD900 is being certified to Appendix C of FAR Part 27, "Criteria for Category A." For certification as a FAR Part 27 Category A aircraft, compliance with specified FAR Part 29 rules must be demonstrated. As required by §§29.1181(a), the compressor and accessory sections of turbine engines are part of the designated fire zones. The engine firewall, required by §§29.1191(a)(1), is located aft of the compressor and accessory sections. The installation leaves the compressor and accessories forward of the designated firewall and exposed to the flammable fluid zones in the upper deck of the helicopter.

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FAA POSITION:

The proposed design for the Boeing Model MD900 (MD902) is intended to meet the requirements of FAR 27, Appendix C - Criteria for Category A. The Boeing MD900 design does not have firewall isolation for the engine compressor and accessory section. The powerplant package includes two Pratt & Whitney PW206E reverse flow engines whose configuration features an accessory section that is forward of the compressor section. This type of engine makes literal compliance with FAR 29.1181(a), Designated Fire Zones, and FAR 29.1191(a), Firewalls, complex due to the need to separate the compressor inlet from the accessory section and the combustor section.

A strict interpretation of the rules would require that the accessory section be designated as a fire zone, which in turn would require isolation with a firewall and further necessitate fire detection and extinguishing provisions for that zone.

This powerplant firewall configuration has been certificated on other helicopters with similarly configured engines without designating the engine accessory section as a fire zone. Transport Directorate policy also exists for several similarly configured turbo-prop and turbo-fan airplanes wherein an equivalent level of safety was established for compliance to similar requirements. Service history has validated this philosophy over a broad range of aircraft types and models.

In order to provide an equivalent level of safety, Boeing must show as a minimum:

1. Designate the engine accessory section as a flammable fluid leakage zone.
2. Show effective isolation of all ignition sources inside the engine accessory section from all potential flammable fluid/vapors (including fuel, oil, hydraulic fluids, etc.).
3. Show that the surface temperatures of all components (including any bleed air lines) within the area, even under failure mode conditions, will remain below the auto-ignition temperature of any flammable fluids/vapors.
4. Demonstrate by test and/or analysis that structure, rotor systems, and control systems located in this area are fireproof in the event of a powerplant fire (Ref. 29.861).
5. Show that all electrical components within this area are incapable of being an ignition source (e.g., starter-generator, HMU, FADEC, wiring connectors, other accessories, etc.).

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6. Show that the design makes any and all flammable fluid leakage extremely remote; if leakage should occur, that no contact with potential ignition sources can be made.
7. Show that fire propagation from the engine hot section into the accessory section is extremely improbable.
8. Show that accessory section "burn-through" is extremely improbable.
9. Show that an engine fire will not propagate forward into an unprotected area against airflow of a running engine.
10. Address the advisability of providing a fire detector(s) for the engine accessory section area.

APPLICANT'S POSITION:

The MD900's Powerplant Installation was originally certified to FAR Part 27 with Category A Engine Isolation. The original MD900's certification did not, however, show compliance with Category A Performance (with the exception of engine cooling per FAR Part 29.1145 and .1147), nor did it fully comply with full Category A Design requirements as stipulated within FAR Part 29. McDonnell Douglas Helicopter Systems (MDHS) proceeded to develop the necessary design modification to certify the MD900 to full Category A Performance and complete Category A Design.

In order to show complete compliance with Category A design requirements under FAR Part 29 for the Powerplant Installation (specifically 29.861, and 29.1181 through 29.1191), the engine's Fuel Metering Unit (FMU) and associated fuel lines were encapsulated within a vapor proof, fire proof shroud to isolate flammable fluid sources from the engine's accessory section (ignition sources). This design approach is similar to that incorporated, and FAA approved, on other Part 29 Category A rotorcraft. MDHS showed compliance to the Category A powerplant fire protection requirements by similar type design to these installations. This type design provides an equivalent level of safety to the applied rules which have been found to be acceptable to the FAA in the past.

MDHS also maintained the additional design features that were implemented in the engine accessory sections and upper transmission deck in showing compliance with the more stringent rules for fire protection and fire safety under FAR Part 27.861, 29.861(a), and 27.863. Compliance to these requirements have been demonstrated and documented in the MD900/901 Fire Safety Plan document number 900FR300320. Revision C to this document was submitted to and approved by the FAA. The Fire Saftey Plan documented appropriate compliance to items 1 through 6, 9, and 10 of the FAA position in this issue

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paper. Items 7 and 8 are considered by the Boeing Company to have been compliant by the fact of the engine certification to FAR Part 33.

As noted above, the design guidelines for MD900 Category A Engine Installation followed the guidelines and/or requirements of FAR Part 27 and those applicable FAR Part 29 requirements as stipulated within Appendix C of FAR Part 27. The additional FAR Part 29 design requirements for the Category A MD900 include the following:

Applicable FAR	Description
29.861 (a)	Fire Protection of Structure, Controls, and Other Parts
29.901 (c)	Powerplant Installation (Category "A" Engine Isolation)
29.903 (b)	Engine Installation
29.1181 (a)	Designated Fire Zones: Regions Included
29.1187 (e)	Drainage and Ventilation of Fire Zones
29.1189 (c)	Shutoff Means
29.1191 (a)(1)	Firewalls
29.1193 (e)	Cowling and Engine Compartment Covering
29.1195	Fire Extinguishing Systems

In order to comply with the aforementioned requirements, modifications to the MD900 Engine Installation type designs were made. A description of the modifications made, and the assessment to the stated requirements is provided below:

a) Shrouded Fuel Metering Unit (FMU): The addition of FMU shrouds on each engine's accessory gearbox provides a means of compliance to Category "A" engine isolation requirements for designated fire zones under FAR Part 29.1181 (a). FAR Part 29.1181 (a) requires that, for turbine engine installations, the compressor and accessory sections be considered a "fire zone" and therefore must by isolated with a firewall as defined in FAR Part 29.1191(a)(1). The original MD900's engine accessory sections were not considered to be a "fire zone" and therefore provide no isolation between the two engine accessory sections and/or subsystems within this zonal area. For the Category A MD900 design, the engine accessory section component that contains and carries flammable fluids was isolated to the engine's FMU. Therefore, the engine's FMU was considered to be a fire zone and required to be isolated within a firewall. The FMU shroud acts as a firewall in meeting this requirement. The construction of the FMU shroud has been determined to meet the firewall requirements as stated within FAR Part 29.1191 (a)(1). In summary, the design implementation of the FMU shrouds provides isolation of the fuel control unit within a fire zone and provides isolation

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of this fire zone from the other engine and other subsystems within this zonal area. Verification of compliance to the stated requirements was made by type design (Ref. 90007600100-101 and -101 Engine Build-Up Installation, Left and Right drawings).

b) Shrouded Fuel Feed Lines/Hoses: The fuel feed lines from the engine deck to the engines FMUs are located outside of the FMU shrouds (or fire zone). The fuel feed lines are enclosed within fireproof fuel shroud hoses to prevent any type of fuel feed line failure from affecting the adjoining engine and/or other subsystems within this zonal area. The fuel shroud hoses are attached to the bottom of the FMU shroud and to the engine feed line deck fitting. These shrouds divert any excess (leaking) fuel into a drain system that eventually deposits the fluid overboard. This design mandates that a dual system failures must occur before there exists any possibility of a negative impact to another engine and the surrounding subsystems. In summary, the design implementation of the fuel shroud hoses provides for isolation of flammable fluid outside of the designated fire zone and provides drainage of the FMU fire zone in meeting the requirements of FAR Part 29.1187. Verification of compliance to the stated requirements was made by type design (Ref. 90007600100-101 and -101 Engine Build-Up Installation, Left and Right drawings).

c) FMU Shroud Ventilation System: Fireproof ventilation ducts are installed on the top of each FMU shroud and ducted outboard of the rotorcraft to facilitate venting of fuel vapors generated by the engines FMU's. This was implemented to ensures that no hazardous amounts of flammable vapors would be present within the zonal area of the two engines accessory sections and the aft transmission deck. This system acts to isolate fuel vapors in a manner that would restrict the impact of a given component failure (ignition source) to the remaining engine and surrounding subsystems. In summary, the design implementation of the FMU ventilation ducts provides for isolation of flammable vapors inside of the designated fire zone and provides ventilation of the FMU fire zone in meeting the requirements of FAR Part 29.1187. Verification of compliance to the stated requirements was made by type design (Ref. 90007600100-101 and -101 Engine Build-Up Installation. Left and Right drawings).

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CONCLUSION:

The FAA has reviewed the design and the documents referenced above and concurs with the applicant's position that enclosing the engine fuel control unit within a fireproof shroud, providing the appropriate flammable fluid vents, and eliminating possible ignition sources in this area provides an equivalent level of safety to §29.1181(a) and §29.1191(a)(1).

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6/5/98
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